

Maintenance of 33 KV / 11 KV Outdoor Substation

(Central Power Training Institute)

P. Saran Chinmai	19071A0236
Y. Poojitha	19071A0260
K. Sai Sathwika	20075A0202
V. Saketh	19071A0257
M. Ajay	19071A0227

Under the Guidance of

Dr. K. Veeresham

Associate Professor



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Motivation

- Uninterrupted electric power supply is essential for Railways, Industries, and Medical Institutions.
- The proper upkeep and maintenance of sub-station & its equipment are necessary to ensure reliability and availability of electrical power supply to the users.

Objectives



Primary objective of maintenance is to ensure a long lasting equipment life cycle without abnormal failures and outages.



Maintenance shall ensure that the system is kept in proper operational condition at all times .



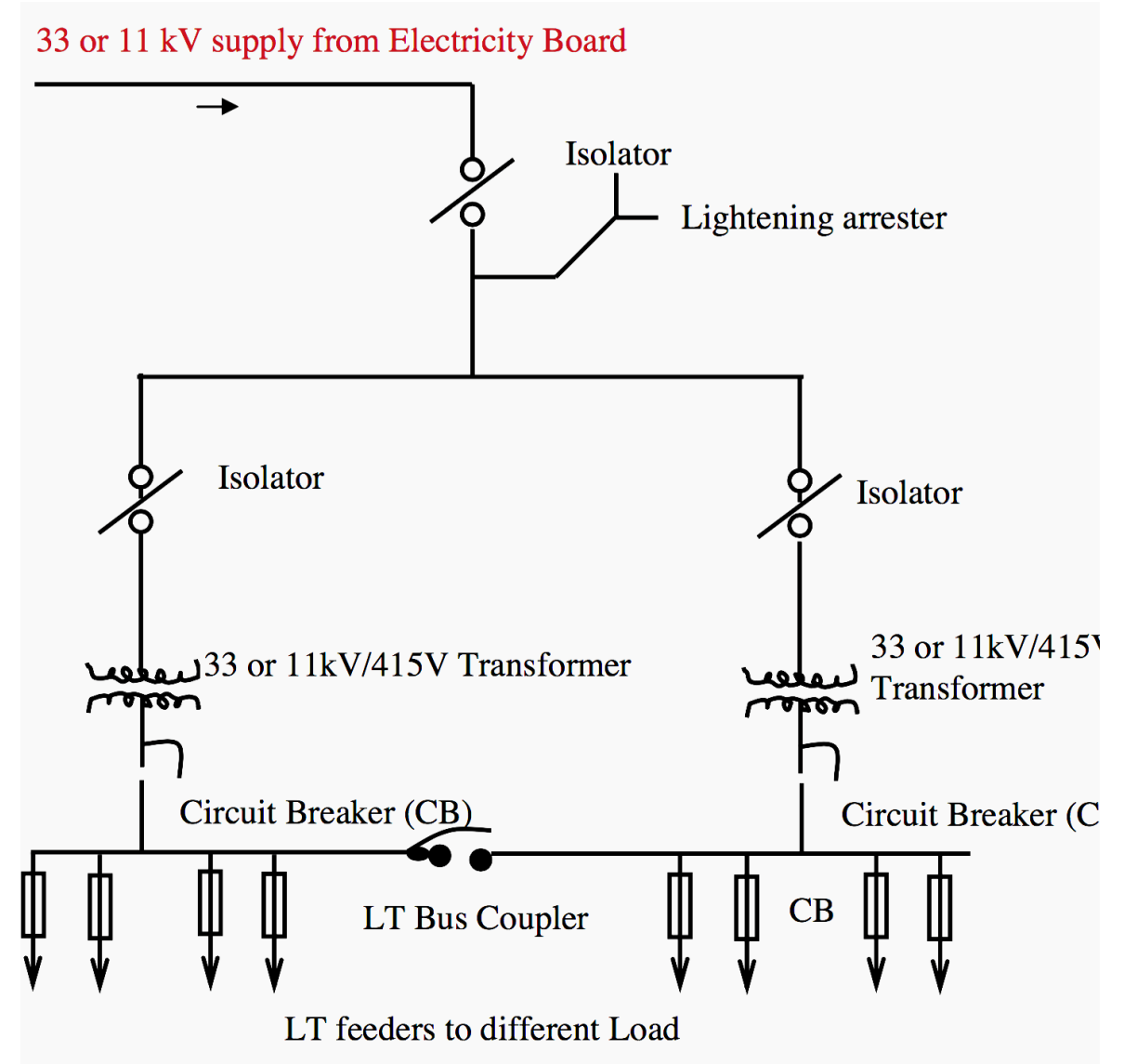
Maintenance shall secure the highest degree of energy availability and reliability.



Introduction

- Electrical General Services Sub-station is a distribution sub-station from which electric supply is distributed to the different users. In a substation there are numbers of incoming and outgoing circuits each having its isolator, circuit breaker, transformers etc.
- It consists of many of periodic schedule maintenance, regular inspections, testing and rectification.

Single Line Diagram of 33/11 kV/440 V Sub-station



Few Equipements installed in Electrical General Services Sub-station:

- Distribution Transformer
- Circuit breaker
- Lightning Arrester
- Air Break (AB) switches/ Isolator
- Insulator
- Bus-bar
- Capacitor Bank
- Fencing



DTR / PTR (Transformers)

Transformers are main and largest equipment of Electrical General Service Sub-station.

Transformers parts and components :

- Primary winding Secondary winding
- Transformer tank Conservator
- Cooling tubes Breather
- Buchholz Relay Explosion vent
- Tap changer Oil inlet valve
- Oil outlet valve Oil level indicator
- L.T. terminals H.T. terminals



Capacitor Bank

It is a series parallel combination of capacitors required to improve power factor of the system. They act as reactive power generators, and provide the needed reactive power to accomplish active power of circuit. This reduces the amount of reactive power, and thus total power (kVA) or the demand. The bank should be provided as near as possible to load.



Maintenance Schedule

- The schedule maintenance of equipment installed in sub-station is essential to ensure trouble free service and avoiding un-necessary interruptions.
- Item wise activities involved in various schedules of sub-station equipped with transformers up to 1000 kVA are as follows:
 - Daily Schedule
 - Monthly Schedule
 - Quarterly Schedule
 - Half Yearly Schedule
 - Yearly Schedule
 - Five Year Schedule

1.Daily Schedule

Items	Schedule Inspection	Action required
Switch yard		
Yard	Growth of unwanted shrubs, garbage etc.	Keep the yard free from shrubs, garbage etc.
Earth pits	Check neatness and tidiness	Maintain tidiness and do watering
Earth connections	Check all connection ends at earth pits and metal parts	Ensure solid connection
Transformer		
Oil level	Check oil level in conservator	If low, top up with dry oil.
Connections	Open terminal box cover and check connections visually for flash/spark marks	Take corrective action
Dehydrating breather	Check air passages. Check colour of silica gel	Clear passages, if required. Reactivate silica gel if found pink
Cleaning	Entire transformer body externally	Clean entire transformer externally including bushings
Buchholz Relay	Check gas in the chamber	Take corrective action
Control Panel Room		
Load (amp.)	Check load balancing	If found unbalance, distribute the load equally on all phases
MCCB/Fuse	Check current ratings	Provide proper size of MCCB/ Fuse according to load condition

2.Monthly Schedule

Items	Schedule Inspection	Action required
Switch yard		
All jumpers & other connections	Check visually for flash/ spark marks	Tighten the respective bi-metallic clamp/ connection
Transformer		
Temperature	Check oil temperature during peak load hours. Check ambient temperature	Either switch off some load or share with other transformer
Tank	Check for oil leakage	Arrest the leakage
Dehydrating breather	Check visually colour of silica gel	Ensure blue colour of silica gel
Control Panel Room		
Relays	Check visually target position	Take corrective action
MCCB/Fuse		
Load (amp.)	Check against rated figure	Reduce load if higher
Voltage	Check against rated figure	Take corrective action
PF meter	Monitor the PF reading	Take corrective action. It should be nearly unity
General	Ensure general cleanliness of room and panels	
Capacitor Bank		
All connections	Check visually for flash/ spark marks	Tighten the clamp/ connection

3. Quarterly Schedule

Items		Schedule Inspection	Action required
Switch yard			
	Support Insulators	Examine for cracks, rust and flash/ spark marks	Clean and replace if required
	Lightning arresters	Check line and earth connection	Clean and ensure rigid connection
	AB switch/ Isolator	Check for proper operation Check line and earth connection	Clean and lubricate Ensure rigid connection
	Jumpers	Check all jumpers	Tighten, if required
	HT bus bars	Examine bus-bar expansion	Tighten, if required
Transformer			
	Bushing	Examine for cracks, rust and flash/ spark marks Check for oil seepage	Clean and replace if required Arrest leakage
Control Panel Room			
	Load (amp.)	Check load balancing	If found unbalance, distribute the load equally on all phases
	MCCB/Fuse	Check condition for overheating	Replace, if required
	LT Bus bars	Check visually for overheating, flash/ spark marks	Take corrective action

4. Half Yearly Schedule

Items		Schedule Inspection	Action required
Transformer			
	Oil	Check BDV	If BDV < 30 kV/cm, do filtration to restore quality of oil.
	Cable box, gasketed joints and gauges	Inspect for leakage and cracks	Take corrective action
Control Panel Room			
	Load (amp.)	Check load balancing	If found unbalance, distribute the load equally on all three phases
	Oil circuit breakers	Check oil level in the tanks. Test the oil, if shows signs of moisture, carbonization or dirt. Check all valves for oil leakage. Check the condition of all gaskets provided to prevent entrance of water and leakage of oil.	Maintain at the proper height. Filter or replace if necessary. Arrest leakage Ensure they are healthy.
	ACB	Check entire unit	Clean with lint free cloth
		Check contacts	Clean fixed and moving contacts
		Operation	Clean and lubricate operating mechanism
		Check tripping of relay	Re-set if required

5. Yearly Schedule

Items		Schedule Inspection	Action required
Switch yard			
	Concreting/ coping of the supports	Check the condition of the concreting/ coping of the supports of the structures. The supports fixing to earth become weal and during the time of heavy rains, cyclone or flooding, the structure may fall, leading to a major breakdown.	If there are cracks or the coping of concreting is coming off, preventive action may be taken to concrete or coping.
	Gravel/crushed rock	Check leveling, oil stain and dust accumulation	Spray water to remove oil stain and accumulated dust. Maintain leveling to avoid formation of water pools.
	Earth resistance	Measure the earth resistance of individual equipment earth pit, preferably during summer	If it is beyond permissible limits, take corrective action
	Earth connection of metal parts	Check the earth connection of metal parts to ensure that the metal parts are properly connected to the earth so that any earth fault of the metal parts is cleared quickly and efficiently. If not, accidents may happen.	Take corrective action
	AB switches	Check operation.	Lubricate and ensure proper operation
		Check the line and earth connection of AB switches.	Ensure they are connected properly
	HT lightning arresters	Measure IR value Line-Earth	If low, replace it.
		Check the line and earth connection of HT lightning arresters	Ensure they are connected properly
	Connections from and to bus-bars	Check the connections	Tighten the connections properly from the bus bars and bars to the lines.
	Insulators	Clean and check all insulators for any crack or damage, flash/ spark marks.	Change, if cracks or damages are developing
Transformer			
	Winding	Measure IR value HV-Earth HV-LV LV-Earth	If low, investigate and take corrective action

Items		Schedule Inspection	Action required
	Oil	Check BDV	If BDV < 30 kV/cm, do filtration to restore quality of oil.
		Check for incipient faults	Perform dissolve gas analysis (DGA) as per annexure - B
	Buchholz relay, alarms and their circuits etc.	Check floats, alarm contacts, their operation, fuses etc. Check relay accuracy, etc.	Clean components and replace contacts and fuses if necessary. Change the setting, if necessary.
	Earth resistance	Check values of earth resistance	If high, investigate and take corrective action
	Body	Check for peelings/ rusting/ damage	Repaint, as required
	Cable box	Check the sealing arrangement for filling holes	Ensure sealing arrangement for filling holes

6. Five Yearly Schedule

Items		Schedule Inspection	Action required
Switch yard			
	Gravel/crushed rock	Check condition, up layer and size	Remove rounded pieces and muck by screening. Maintain up layer of 100 mm by additional quantity of size 40mm
Transformer			
	Conservator	Inspect inside for sludge etc.	Clean or flush inside with oil
	Core and windings	Overall inspection including lifting of core and coils	Wash with clean dry oil.
	Rollers	Examine carefully during overhauling	Grease them properly
	Circuit breaker	Examine carefully during overhauling	Overhaul every circuit breaker completely

Precautions

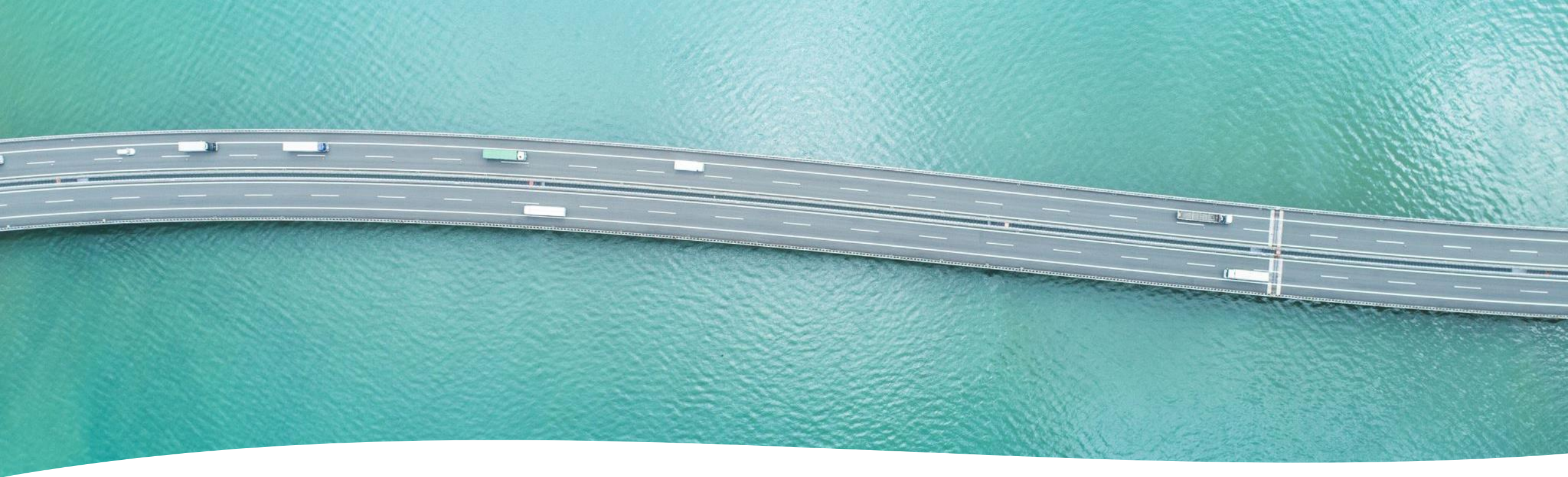
- Ensure all arrangements are safe.
- Isolate the transformer from supply and earth the terminals properly.
- Check & record the oil level in the tank before unseal the tank and unscrew the nuts and bolts.
- Ensure the work place is fire proof; care should be taken to prevent fire.
- Put a caution board “NO SMOKING”.
- The staff should not have anything in his breast pocket and should not wear watch or ring.

Conclusion

- ❖ The maintenance practices followed, play a vital role in ensuring reliable power supply.
- ❖ A well planned maintenance schedule of each & every equipment will ensure trouble free service and reduction in interruptions / failures.
- ❖ The principal object of transformer maintenance is to maintain the insulation in good condition. Moisture, dust and excessive heat are the main reasons of insulation deterioration and avoidance of these will keep insulation in good condition.

References

- ❑ Handbook on Maintenance of Electrical General Service Sub-Station(3)
- ❑ IS: 10028 (Pt.III) - 1981, reaffirmed 1993 & 1998 –Code of Practice for Selection, Installation and Maintenance of Transformers (Part– III Maintenance).



Thank You